THESIS ON

T H E V E R M I F O R M A P P E N D I X

HISTOLOGY AND MORBID ANATOMY

EXAMINATION OF ONE HUNDRED AND SEVEN EXAMPLES

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In view of the fact that so much attention has been bestowed of late on the vermiform appendix by several pathologists of note, the present contribution may appear somewhat superfluous. The important thesis published in 1893, by Dr. Kelynack deals with the anatomy and pathology of the appendix, but touches but lightly on the minute structure of the organ, and it is hoped that as regards histological details the following record of the microscopic examination of one hundred and seven appendices may not be without value.

The specimens have been obtained from a variety of sources, and fall into natural classes.

A. 35 so-called normal appendices which have been removed post-mortem from the bodies of patients, in whom inflammation of the appendix has not been diagnosed during

life, and who have died from diseases other than appendicitis.

B. 27 obtained similarly from the bodies of insane patients, previously resident in the Yorkshire West Riding Asylum, Menstone and the L. C. C. Asylum, Claybury, in whom as far as is known no symptoms of any lesion of the appendix were present during life.

C. 26 removed by surgical operation from patients suffering from appendicitis.

D. An examination has been made of the appendix in two instances of the human foetus.

E. The caecum and appendix (where present) has been examined in 17 of the lower vertebrates, the examples being taken from various groups.

Notwithstanding the views put forward by various physiologists attributing some definite glandular or other special function to the vermiform appendix, it

is undoubtedly now generally regarded as a rudimentary and degenerated structure in man. It has been described by Talamon as "Un organe inutile et nuisible," and Darwin in his "Descent of Man" refers to it as follows. "It appears as if, in consequence of changed diet or habits, the caecum has become much shortened in various animals, the vermiform appendix being left as a rudiment of the shortest part. That this appendage is a rudiment we may infer from its small size, and from the evidence which Professor Camestrine has collected of its variability in man. It is occasionally quite absent, and again is largely developed. In the orang the appendage is long and convoluted. In man it arises from the end of the short caecum, and is commonly from four to five inches in length, being only about the third of an inch in diameter."

From examination of the lower part of the intestine in as many of the lower vertebrates as I have been able to obtain, I have summarized my

results as follows:-

I. REPTILIA (WATER - SNAKE)

The alimentary canal is a continuous straight tube with a simple dilatation marking the stomach, which is lined by mucous membrane arranged in well defined transverse ridges. Below the stomach the canal narrows, and the mucous membrane shows transverse ridges much finer than those of the stomach. The tube is relatively short, and shows no further differentiation into parts. It is slightly coiled at its distal end.

II. AVES

In this group, I examined the intestine of -

(a) Fowl (gallus bankiva)
(b) Chick
(c) Wigeon (anas penelope)
(d) Bulfinch (pyrrhula vulgaris)
(e) Tomtit (parus major)
(f) Bluetit (parus minor)
(g) Starling (sturnus vulgaris)

and found on the whole conformity to the arrangement usually attributed to birds. In each case two caecal diverticula were present, varying somewhat in position. In fowl and wigeon they arise from the posterior wall of the upper end of the rectum. In the smaller birds they arise relatively nearer the lower end of the intestine, and are proportionately shorter and contain in their walls more lymphoid tissue than do the diverticula of the larger birds.

In the Fowl (two examined) the right and left caeca measured respectively 19 and 18 cm. in length, and about .5 cm. in width at the proximal ends where the walls are thickened by masses of lymphoid tissue. At the distal ends they were 1.5 cm. wide and thin-walled. At the extreme tip they become narrow and full of lymphoid tissue. The lumen was patent throughout, and the right diverticulum was filled with material similar to that in the gut.

Microscopic Examination: A transverse section of the distal end shows from without inwards a well defined peritoneal coat puckered over one-eighth of

its circumference, there being no mesentery. A narrow layer of longitudinal muscular fibres enclosing a layer of transverse fibres double the width of the longitudinal. A submucous layer containing vessels, round cells, and lymphoid nodules, and sending prolongations down through the transverse coat (hiatus muscularis). The muscularis mucosae can be traced where the submucous layer is widest. The mucous membrane consists of a broad band of lymphoid tissue, in which are embedded the lower ends of Lieberkühn's crypts. No goblet cells are seen. The above description holds good for a section taken through the proximal end, with the exception that the mucous membrane is characterized by long irregular processes of lymphoid tissue devoid of epithelium, protruding from between the crypts. Passing up the middle of each process is a strand of connective tissue. B. coli was found in the lumen.

In the Chick (7 days old) well developed caecal diverticula were present, 3.5 cm. in length. Lumen patent and containing faecal matter.

Microscopic appearance of a transverse section is very similar to that in fowl, except that the lymphoid processes are large, and quite regular in outline, and are covered throughout by a well defined continuous layer of epithelium.

In Wigeon the details are practically the same as in the fowl, but the muscular layer is much wider.

Bullfinch (Pyrrhula vulgaris): Caecum of a very young bird was examined. Two minute caeca were present, but the intestine was too soft to be preserved.

Bluetit (Parus coeruleus): The diverticula are attached to the gut wall by a layer of very loose connective tissue containing fat cells. Each caecal diverticulum has a very thin wall, consisting of a few strands of muscular fibres, not differentiated into longitudinal and transverse. No submucous tissue is present, but the rest of the section consists of lymphoid tissue, in the centre of which is a single layer of endothelial cells, showing in section a cruciform arrangement (See section and photograph). Well marked goblet cells are present, filled with mucus. Some of the mucus may be seen

lying loose in the lumen.

Tomtit and Starling:: In all essential details the diverticula are similar to those of the bluetit: but the endothelium is not so simply arranged, and shows more convolutions.

III. MAMMALIA

In this group I examined the intestine in -

(a) Pig (Sus scrofa)
(b) Sheep (Ovis aries)
(c) Kid (Capra hircus)
(d) Hare (Lepus timidus)
(e) Rabbit (Lepus cuniculus)
(f) Guinea-pig (Cavia cobaya)
(g) Rat (mus rattus)
(h) Cat (Felis domesticus)
(i) Kitten, foetal.

Pig and Sheep: No trace of any appendix is present. There is no lymphoid tissue at the free end of the dilated and thin-walled caecum.

Kid: The caecum is not relatively so long as in pig and sheep, and its free end is somewhat constricted. The walls at this part appear thicker

than those of the rest of the caecum, and show in section abundant lymphoid tissue.

Two Hares: There is a well marked appendix, 9 cm. in length. There is no sign of any fold of mucous membrane at the junction of the appendix and caecum on slitting the organ. The caecal wall is very thin and almost transparent, and on its inner surface are delicate frills of mucous membrane, about .3 cm. in width, and about 2 cm. distant from one another, crossing the caecum transversely. The appendix is white, opaque, and markedly glandular in appearance, and about one-third the width of the caecum. There is a ring of similar glandular tissue surrounding the ileum at the ileo-caecal junction, but no such tissue is present in the caecum itself.

Microscopically the arrangement of the appendix resembles that in the rabbit, excepting that the epithelium is not so much branched, and the cells appear to be in an active secreting state. Masses of mucus are seen. The structure is more particularly described in the case of the rabbit as the hares were not fresh when examined, and some post-mortem changes

had occurred.

Rabbit (Tame and Wild): The anatomical arrangement was similar to that in the hare, except that in the tame rabbit the glandular mass at the ileo-caecal junction was very largely developed, forming a nodular mass. On transverse section the appendix was seen to contain faecal matter similar to that in the caecum. The lumen was patent throughout, but varied considerably in width. The walls of the organ were thickest where the lumen was narrowest, so that outwardly the appendix appeared uniform in its calibre.

On microscopic examination there is a very narrow muscular coat consisting of a few strands of outer longitudinal and inner muscular fibres, and separating the mesentery from masses of lymphoid tissue. These masses are separated into regular blocks by narrow strands of connective tissue giving in section a tessellated pavement appearance. The blocks of lymphoid tissue nearest the lumen are covered with a single layer of epithelium containing large goblet cells. Between these blocks issue branching processes of epithelium, which join to

form arches of epithelium over the blocks of lymphoid tissue.

Guinea-pig and Rat: No trace of an appendix is present in either.

Cat: At the end of the caecum there is a short, thick glandular portion. Masses of lymphoid tissue are present, and the crypts of Lieberkühn are straight and closely set together, being almost continuous. They contain many large goblet cells.

Kitten; (Foetal): There is a well marked but very short caecum containing meconium, which arises like a small bud from the posterior wall of the gut. It shows no trace of lymphoid tissue at its apex, and the epithelium is peculiar in that it contains an extraordinary number of large goblet cells.

D. In the human foetus according to Milnes Marshall the caecum arises during the fifth week as a diverticulum from the distal limb of the vitelline loop, not far from the point of attachment of the yolk stalk. Another observer states that by the end of the first two and a half months the appendix is quite

distinct.

I have examined two foetal appendices (twin, 5 months). In No. 1 the appendix is 1.8 cm. long and spirally coiled, and arises directly from the apex of the caecum. The anterior caecal wall bulges more than the posterior. The lumen of the appendix is patent throughout and contains meconium.

The length of the appendix of No. 2 is 2.6 cm. and it is doubled twice on itself, otherwise it is similar to No. 1. In each case the tip of the appendix points to the spleen.

Microscopic Examination: The mucous membrane resembles very closely that of the colon in its histological structure. There is much lymphoid tissue present. The epithelium dips down between the lymphoid masses to form crypts, and in these takes on a deep stain, possibly indicating the secretory character of the crypts. Goblet cells are very numerous over the villi of the ileum, but are scarce in the caecum and appendix. In the specimen stained with carbol-thionin, the different stages in secretion of the epithelial cells is

well shown.

A. In the group of appendices from hospital post-mortem rooms, seven are those of children under nine years of age. These are of some interest as two show tubercular lesions, one from a case of burns shows slight inflammation, the others show marked atrophy of the appendicular walls.

There was considerable variety in the length of the appendix, as may be seen from the adjoining table:-

	Age	Length
W. W.	11 months	4.8 cm.
A. A.	17 "	3.1 cm.
T. G.	19 "	5.6 cm.
W. F.	2¾ years	6 cm.
K. A.	4 "	7.2 cm.
B. W.	5 "	5.7 cm.
A. S.	6 "	4.6 cm.

W. W. Admitted to hospital with abdominal enlargement of three months' duration. Great emaciation. Masses felt all over abdomen. Diarrhoea. Right lobar pneumonia developed two days after admission.

Temperature 107.8°. Child died twenty-four hours after onset.

Post-mortem - Pneumonia of right upper and middle lobes. No tubercles seen in lungs. Tuberculous peritonitis of ulcerative type. Tubercular liver and spleen. Appendix mesentery fibrous. Apex is embedded in a mass of glands and connective tissue, there are enlarged glands scattered over the caecum on its posterior aspect, and also in the ileo-caecal angle. The appendix is adherent to the caecum at its distal part. On section through the length of the appendix, the free end is seen to be sharply bent upon itself, so that the distal end and the proximal look in the same direction, and the lumen is constricted. Sections were cut of the following:-

1. The free end with its surrounding tissue and bend.
2. Large mass of glands with gut wall adherent.
3. Six small glands.

Microscopic Examination of the apex shows that many of the epithelial cells are vacuolated, and are mostly absent between the crypts.

The muscular walls are very thin, and consist of an open connective tissue, scattered through which are a few muscular fibres. It is not well differentiated into layers at any part, and the peritoneum can scarcely be defined, being closely adherent to a mass of dense cellular connective tissue. In this tissue are seen several large cells with multiple nuclei, lying in clear spaces, not altogether resembling the definite giant cells of a tubercular lesion.

A section through the bent portion shows well-defined masses of tissue lying between the distal and proximal limbs of the bend. There are small areas of necrosis in this tissue, and at the edge of one of these a typical tubercular giant cell is seen (See section). All the six glands show well marked giant cells. On staining with Ziehl-Neelsen for tubercle bacilli, one was found in one of the glands.

A. A. Post mortem examination revealed tubercle in lungs, nothing in intestine. Appendix. Mesentery

is thin and transparent, containing large blood-vessels at its free border from which four branches pass off to the appendix. It does not arise from the apex of the caecum, as is said to be often the case in children. The external surface is smooth and uniform. On section it is found filled with semi-transparent, semi-solid matter.

Microscopic Examination: Considerable puckering of the appendix on the side of the mesentery is seen. The muscular coat shows great atrophy, especially the transverse layer. A number of round cells, and some detached epithelium lies free in the lumen. The submucous coat is comparatively wide and contains very few cells, and no large vessels. At certain points it shows slight inflammation, being infiltrated by leucocytes from the adjacent mucous membrane. The mucous membrane is devoid of epithelium excepting in the crypts.

T. G. Died of tuberculosis of lung. The appendix has a thickened and fibrous mesentery. It is closely adherent to the posterior portion of the caecum

throughout its length. The appendix is twice doubled on itself in its middle third, but is not constricted. There are enlarged glands on the posterior aspect of the caecum, but none in the appendiculo-caecal angle.

Sections were cut of:-

1. The apex.
2. The caecal end.
3. Four enlarged glands.

1. Microscopic examination of the apex shows that its general character resembles that in the previous case, except that it is free, and not surrounded by tubercular tissue. The lumen in the case of A. A. was empty, while in this case it contains faecal matter, a few round cells, degenerated epithelial cells, and large masses of bacteria resembling B. coli.

2. The caecal portion shows tubercular tissue closely adherent to the gut wall, and indistinguishable from it in places, and containing typical tubercular giant cells.

3. The four glands show giant cells. Stained with Ziehl-Neelsen's fluid no tubercle bacilli were found.

W. F. Died in a week from extensive burns of the second and third degree on the chest, abdomen, and both arms. The left arm being especially affected. The patient was a healthy, well-nourished boy. Post-mortem - deep congestion and oedema of the lungs was found. The appendix was 6 cm. in length. The mesentery was wide and contained masses of fat. There was a marked constriction at the distal part 1.2 cm. from the free end. Another slight constriction was present 1 cm. from the caecal end. On slitting the appendix the lumen was patent throughout. Microscopic examination of the terminal 2 cm. cut longitudinally shows that there is considerable congestion. The mesenteric vessels are gorged with blood, some of which can be seen lying in the connective tissue. The muscular walls are well developed, and show increased vascularity, which is observed also in the other parts of the appendix.

There is a large amount of lymphoid tissue, and the epithelium in some of the crypts appears to be in a state of active secretion. Contents of the lumen are mucin with a few round cells.

In the appendices of K. A., B. W., and A. S. there is nothing of special note except that the muscular coats are wasted, and the submucous coat broad and homogeneous-looking. The contents of the lumen in K. A. are epithelial cells recently shed, and not degenerated, round cells, and small collections of colon bacilli. There are also some large rod-shaped bacilli, probably post-mortem in origin.

In B. W. there are large masses of colon bacilli, a few round cells, and degenerated epithelium. The bacilli can be seen in the glands, and a few in the mucous membrane outside them, among the round cells. No cocci are seen.

In A. S. there are also numbers of colon bacilli, lying in some homogeneous material, which takes on a very light stain. These have been

noted recently by Mr. Lockwood, who calls them bacterial masses, and regards them as the first stage in concretion formation.

In some of the abnormal appendices to be described later, I have found these masses in recent concretions. The adult appendices examined, 28 in number, are classified as follows:-

No.	Sex	Age	Condition of Appendix	Concretions	Length	Cause of Death
1	F.	19	Apex twisted. Lumen contains faecal matter	None	10.8 cm.	Addison's Disease, Pulmonary Consumption
2	M.	19	Wide, much puckered	None	8.4 cm.	Miliary tubercle
3	M.	24	Hard fibrous cord	None	6.7 cm.	Pneumonia
4	M.	25	Adhesions. Lumen occluded	None	5 cm.	Opiom Poisoning
5	F.	25	Hard rounded cord, folded over at its caecal end	None	11.3 cm.	Interstitial nephritis
6	F.	26	Kink 3 cm. from caecal end	None	8.5 cm.	Typhoid
7	F.	30	Normal	None	6 cm.	Cardiac disease
8	M.	32	Kinked at mid point	None	8.2 cm.	Amputation Thigh

No.	Sex	Age	Condition of Appendix	Concretions	Length	Cause of Death
9	F.	33	Coiled in a ring, not kinked	None	5.8 cm.	Malignant Disease
10	M.	34	Tense, apex dilated, stuffed with faecal matter	1 Hard	9 cm.	Acute Nephritis
11	M.	34	Kinked near caecal end	None	8 cm.	Cirrhosis Liver
12	F.	35	Three apertures in mucous membrane leading to cavities beneath	None	5.8 cm.	Carcinoma coli
13	M.	35	Is three times folded	None	11.5 cm.	Opium Poisoning
14	M.	37	Normal	None	10 cm.	Fractured Skull
15	M.	38	Twice tightly doubled on itself	None	5.8 cm.	Ruptured Aneurysm
16	M.	39	Constricted 2.5 cm. from proximal end	None	8.3 cm.	Double pneumonia, pyonephrosis
17	F.	40	Lumen filled with faeces	1 Small	9.3 cm.	Pneumonia
18	M.	41	Narrows suddenly in last two cm. Enlarged gland at angle	None	7.7 cm.	Tubular nephritis
19	M.	43	Normal	None	8.5 cm.	Pleurisy, congestion lungs, Abscess kidney

No.	Sex	Age	Condition of Appendix	Concretions	Length	Cause of Death
20	M.	44	Normal	None	8.4 cm.	Cardiac Disease
21	M.	45	Walls very thin. Lumen wide	None	3.4 cm.	Acute Peritonitis
22	M.	47	Minute opening into caecum	None	6.7 cm.	Cardiac Disease
23	M.	47	Mesentery continued round apex	None	7.7 cm.	Cardiac and renal
24	F.	48	Folded at proximal end. Lumen occluded past this fold			Chronic bronchitis
25	M.	49	Small, embedded in fat	None	3 cm.	Pneumonia
26	M.	52	Well-marked fold of mucous membrane at junction with caecum	None	10.4 cm.	Acute Peritonitis
27	M.	58	Small, narrow	None	5.5 cm.	Abdominal carcinoma
28			Widest at free end	None	8.7 cm.	

The vermiform appendix varies greatly in its histological character in different individuals at different ages. The normal structure of the vermiform appendix appears somewhat as follows from without inwards.

The peritoneal coat is well marked, and on the inner border of the appendix is prolonged to form the meso-appendix.

The mesentery has been present in all the cases I have examined, and extends to the tip of the appendix. It has been in several cases noted as projecting beyond the apex. In two cases it has been extended over the tip of the appendix, and continued as a narrow ridge on the opposite side: so that in cross section there appears to be a mesentery at each side of the appendix. In some cases it has been infiltrated with masses of fat recalling the appendices epiploicae of the intestine. In others it is fibrous, and in others again is composed of very wide-meshed delicate connective tissue, which would thus give great mobility to the appendix. It is well supplied with vessels.

The muscular coats consist of an outer longitudinal, and an inner transverse layer which is the wider of the two. They vary greatly in thickness.

In some cases they form the greater part of the walls of the appendix, and in others they are very thin.

Passing up between the muscular fibres, delicate strands of connective tissue may be sometimes seen. These usually extend through one layer only of the muscular fibres. Thus a strand may be seen passing up from the peritoneum through the outer fibres, or from the submucous tissue down through the inner muscular fibres.

In a few instances the strand can be traced through both layers of muscular fibres, thus forming a pathway of loose connective tissue extending from the submucosa to the peritoneum.

In the hypertrophied condition of abnormal appendices these are widened and infiltrated with round cells, which thus easily reach the peritoneum.

The submucous layer is usually well marked, and consists of loose connective tissue well supplied with

numerous thin-walled blood vessels.

The mucous membrane contains abundance of lymphoid tissue. This may infiltrate the whole layer evenly, or it may be collected into lymphoid nodules, of which there are from 4 to 8 in a transverse section. These nodules may project into the lumen, resembling Peyer's patches of the ileum. The central part of the nodule stains more lightly than the cortical. According to Lockwood (Proceedings of Anatomical Society, November 1899) this is due to the lymph canaliculi being more capacious in the centre of the nodule. The inner edge of this lymphoid tissue is lined by a single layer of columnar epithelial cells, forming the boundary of the lumen of the appendix. The epithelium dips down into the lymphoid tissue to form the crypts of Lieberkühn: which vary greatly in number in different appendices. They are usually numerous in children and young adults. But in one case in a child of nine very few crypts were seen: and in an adult male subject, age 25, dying of opium poisoning, they were absent in some sections, though

lymphoid tissue was present, and there was no obliteration: and in other sections were from 4 to 15 in number.

In one case of an insane male patient, 74 years of age, they were present in great number, and were branched, which seems to be unusual. The crypts also vary in size and length in different cases. Goblet cells are often numerous. The mucous membrane sometimes rests on a distinct muscularis mucosae, but this is often absent.

LUMEN OF APPENDIX

The normal cases frequently show no epithelial lining to the lumen of the appendix. This is probably due to post-mortem changes, as in the group of insane patients from Claybury, where the bodies are frozen after death, the epithelium is intact. A bacillus resembling B. coli was found in all the normal cases where sections were stained to show micro-organisms. It was not present in great num-

bers, and in no case, excepting in one case of enteric fever, was it found penetrating the mucous membrane. The lumen was in some specimens occupied by faecal matter, which in some cases had become hardened as though about to form concretions. The typical hard laminated concretion, often found in the inflamed appendix was never present. Round cells and mucus were frequently present. In the cases, over 43, some obliteration of the lumen has occurred at the apex. In two cases this extends along the whole appendix to within 1 cm. of its caecal end. One case of a woman of 25, dying of chronic interstitial nephritis, shows early complete obliteration of the appendix, which is reduced to a small hard rounded cord, showing under the microscope on transverse section that it consists entirely of dense fibrous connective tissue, having few blood-vessels.

In Dr. Kelynack's book, one of the cases of complete obliteration of the appendix is also reported as occurring in a case of chronic interstitial nephritis, and might possibly be connected with

the general tendency to fibrosis present in such cases. The lumen varies greatly in size and shape, this is well seen in serial sections taken transversely through the appendix. It also varies in position, being sometimes situated at the side of the muscular coat. This eccentric position of the lumen becomes of great importance in cases of appendicitis, as inflammation will spread more rapidly and easily through the narrower wall. This would especially be the case in one of the group I have examined of abnormal appendices where the lumen lay entirely outside the muscular coats, the sections being cut transversely. In no case have I discovered anything like a cystic dilatation of the appendix, though in one case the lumen was considerably widened distally, the lumen at the proximal end being reduced to a pinhole size.

No valve was found at the junction of the appendix with the caecum. In some cases the mucous membrane formed a slight fold in this situation. In one case a papilla was found covering the aperture, which on section was seen to be formed of connective

tissue with a covering of epithelial cells. In many of the cases the opening was wide, and showed no folding or ridge of mucous membrane.

The appendix shows great variations in length, width, and shape. In the 28 adult cases examined the average length was 7.7 cm. The shortest was 3 cm. long, and was obtained from a man aged 49 who died of pneumonia. The longest was 11.5 cm. and belonged to a man aged 35 who died of opium poisoning. The width varied from about .3 to 1 cm., but was not uniform throughout each appendix.

In 9 cases the appendix was kinked. In one there were three kinks, at the apex, mid point, and caecal end of the appendix. In another the appendix was closely folded three times, each fold being adherent to the other. The lumen is obliterated beyond the first fold. In sections taken through a tight kink, the muscular walls are seen to have coalesced, and the peritoneum has become obliterated. The lumen is constricted. One appendix is much twisted, but shows no constriction of the lumen. In one case the mesentery appears to be shortened, and

consequently the appendix is puckered.

The following appendices I have described in some detail as they all show some pathological change.

Male, 19 years old. Died of tubercular pleurisy.

Post-Mortem: Miliary tubercles in lung and spleen. Appendix is 8.4 cm. long and much twisted. The mesentery is fibrous and short, puckering the appendix. It extends to the apex, which is wide and rounded. The external surface is much marked with ridges of connective tissue, of which there is a large mass at the proximal part of the appendix. The lumen is wide and patent throughout, the walls of the appendix being thin. In section no evidences of tubercle are found. There is some congestion of the lymphoid tissue of the mucous membrane. The peritoneum is thickened, and shows marked congestion, the vessels being large, numerous and engorged. At one place there is infiltration of round cells into the peritoneum.

Female, 26 years old. Enteric fever. Patient died of haemorrhage on the 15th day of illness.

Post-Mortem. One large enteric ulcer about one inch above the ileo-caecal valve. It was very deep, the surface being covered with blood clot and slough, from below which haemorrhage had occurred. Appendix 8.5 cm. long and was kinked .3 cm. from its caecal end. Sections show no ulceration, but in the lumen there are crowds of bacilli, whether B. coli or B. typhosus it is impossible now to determine. They are seen in large numbers in the crypts and some have penetrated to the deeper layers of the mucous membrane. A few are seen in the submucous layer.

Male, 34 years old. Died of acute nephritis. Appendix 9 cm. long, widest at the free end. Is tense and elastic. The mesentery extends to the end. External surface is smooth and regular.

Block I through apex. Section shows no lumen, the central portion being occupied by connective tissue. Mesentery seen on both sides of section as it extends round the apex.

Block II proximal to Block I. In centre of section a small concretion found, surrounded by

mucus entangled in which are short rows of epithelial cells. These have evidently been shed from the surrounding mucous membrane.

Block III. Longitudinal section. Shows marked congestion of the peritoneum.

Block IV. Cæcal end appears to be normal in character and with slightly thickened peritoneum.

Male, 52 years old. Death from acute suppurative arthritis, acute peritonitis and hydatid cyst of the spleen.

Appendix is 10.4 long: apex is pointed, Mesentery fibrous and scanty, and prolonged beyond the tip of the appendix. Lumen patent throughout. Entrance to appendix from caecum covered by a well marked fold of mucous membrane. Transverse section mid-appendix shows the crypts lying loose in the lumen forming one large mass. The cells are greatly swollen and stain lightly. Many similar cases are found among the insane group, and are suggestive of membranous colitis.

Female, 35 years old. Death from malignant ulceration of descending colon.

Appendix is 5.8 cm. in length, and has been split. Apex blunt, external surface ridged. Mesentery fleshy and contains fat. Distally the appendix is twisted and consists of connective tissue. On the mucous membrane are three round pits, the distal and proximal depressions lead into the submucous tissue, and do not penetrate any further, the mid passage is continued as a ragged cavity, extending ¼ inch towards the distal end and 1/8 inch towards the proximal end of the appendix. This is lined with clotted blood.

Block I. Apex, simply connective tissue.

Block II. Proximal to this the section shows the mucous membrane to consist of a band of plain lymphoid tissue with no glands or epithelium in it, into which haemorrhage has taken place.

Block III. A series of sections beginning just distal to the middle ulceration, and extending into it. Here the mucous membrane has a necrosed edge, which is turned over at one side of the specimen. Beneath

this turned edge are a few short rows of epithelial cells. The rest of the mucous membrane is occupied by lymphoid tissue. Below it is a triangular cavity.

Block IV. Transversely through the proximal ulceration. The section shows a small ragged cavity below the mucous membrane. What appear to be swollen nerve cells are seen in the lower layers of the submucous tissue.

B. 27 Appendices were examined from post-mortem examinations performed on insane patients, and are classified in order of age, as follows:-

No.	Sex	Age	Condition of Appendix	Concretions	Length	Cause of Death
1	F.	21	Normal	None	6.5 cm.	Ruptured abdominal vessel
2	F.	22	All vessels enlarged	None	10.3 cm.	Phthisis
3	F.	27	Twice bent	None	5.5 cm.	G. P.
4	F.	32	Twice kinked	None	7 cm.	G. P.
5	F.	32	Rises from apex of caecum	None	7.7 cm.	G. P.
6	F.	33	Lumen occluded 2 cm. from caecum	None	6.7 cm.	Phthisis

No.	Sex	Age	Condition of Appendix	Concretions	Length	Cause of Death
7	F.	33	Normal		4.3 cm.	G. P.
8	F.	35	Surface shows remains of fibrous adhesions	None	8.3 cm.	Early Phthisis
9	M.	38	Normal		8.2 cm.	G. P.
10	F.	40	Normal	None	5.6 cm.	Gangrene lung
11	F.	48	Twice kinked	1	7.7 cm.	Carcinoma uteri
12	F.	48	Free end bulbous carcinomatous	None	10.7 cm.	Organic brain disease
13	F.	49	Lumen occluded 2.5 cm. from caecum	None	7.3 cm.	Syncope in fit
14	F.	50	Narrowest 1 cm. from caecal end	None	8 cm.	Acute phthisis
15	M.	55	Narrowest at proximal end	None	6.6 cm.	Gangrene of small intestine
16	M.	64	Masses faecal matter proximally	1	8 cm.	Acute dysentery
17	F.	68	Seven small tumours opposite mesentery	None	8.5 cm.	Cardiac disease
18	F.	73	Lumen obliterated	None	3.6 cm.	Senile decay
19	M.	74	Lumen patent	Few small	10.2 cm.	Pneumonia
20	F.	78	Lumen continuous throughout	None	6.5 cm.	Cardiac disease
21	F.	87	Occluded 1 cm. from caecal end	None	6.5 cm.	Cardiac disease

No.	Sex	Age	Condition of Appendix	Concretions	Length	Cause of Death
22	F.	89	Occluded 1.4 cm.from free end	None	8 cm.	Senile decay
23	F.		Invaginated apex	None	6 cm.	
24	F.				10.8 cm.	
25	F.				17.7 cm.	
26	F.				9.8 cm.	
27	F.				12.6 cm.	

The average length in this group of appendices was rather longer than in the previous group, being 8.04 cm. The shortest appendix measured 3.6 cm., and was from a demented woman of 73 who died of senile decay. The longest appendix was from a female patient, and measured 17.7 cm., which is the longest I have yet found.

The general structure of the appendix is the same in this group as in the group regarded as normal, there being about the same diversity in size, shape and variations from the normal condition. The patients were older, so that there were more cases

which showed obliteration of the lumen of the appendix. One female patient of 87 years had occlusion of the lumen 1 cm. from caecal end. In another of 89 the occlusion was near the free end. A patient of 73 had occlusion of the lumen near the caecal end, and it also occurred in patients of 33 and 47 respectively at 2" to 2.5 cm. from the caecal end. All these patients were women.

The appendix of one patient, a woman of 32, shows reversion to the developmental type, the appendix rising from the apex of the caecum. It is 7.7 cm. long, and is kinked. The mesentery is prolonged from the free end, and extends 4.5 cm. along the side of the appendix, opposite the mesenteric attachment. Lumen is patent and mucous membrane appears swollen except at the free end.

The following cases are of special interest:-

No. 11. Death from carcinoma uteri. Appendix 7.7 cm. long, .7 wide. Mesentery contains masses of fat. The external surface is smooth, shiny and tense looking and somewhat congested, the free end

being deeply congested. There is a kink at the mesenteric border, extending transversely and towards the apex of the appendix. This causes the free end to be twisted at about an angle of 90°. The surface of the next portion (3 cm.) is somewhat vascular, and appears to be full of some solid material. At the caecal end of this portion there is another kink, arising from the appendix opposite its mesenteric border, causing the caecal end of the appendix to be bent on its succeeding portion, so that at its junction with the caecum it has rotated through two right angles.

On transverse section the lumen is patent, quite to the apex. It contains white material at its free end up to the first kink, the next portion contains dark solid faecal matter, and just distal to the second kink is a semi-hard concretion. The lumen is dilated at the caecal end.

No. 12. Death from organic brain disease.

Post-Mortem: Some tubercle found at both apices. No signs of malignant disease found.

Appendix 10.7 cm. long, 1 cm. wide at its free

end, and .4 at its caecal end. Mesentery is wide and delicate, and loose in structure. It contains fat in large masses over the terminal third of the appendix. The apex is swollen and flask-shaped, showing no kinking. Longitudinal section through the dilated apex shows numbers of carcinomatous cells infiltrating the mucous membrane at the proximal end of the specimen - see Fig. 5. The section also shows a wide gap in the muscular wall, which is greatly hypertrophied, called by Lockwood "hiatus muscularis." Paper on pathology of appendicitis, British Medical Journal, January 27th, 1900, see Fig. 6. A primary carcinoma of the appendix is an extremely rare condition.

In the Journal Hebdomadaire of March 8th 1900, it is stated that three cases of chronic appendicitis and cancer of appendix were found post-mortem in old tubercular subjects. Cancer of the appendix was also found in a child of 12 operated on for acute attacks of appendicitis.

Houdon (John Hopkins Hosp. Bull. July-August, 1900) describes a case of primary and a case of

secondary carcinoma of the appendix. The first was discovered in the course of an operation for retroflexion of the uterus. The case of secondary carcinoma was discovered during an operation for ovarian carcinoma.

No. 17. Death from cardiac valvular disease.

Post-mortem: Large intestine shows thickened mucous membrane in the lower part with ulcerations both recent and of long standing. Large intestine has surface much congested from chronic colitis. Appendix is 8.5 cm. long and .4 cm. wide. The mesentery is wide over the middle 3/5 of the appendix, and contains little fat, and several masses of a hard white substance, lying adherent to the appendicular border. It is prolonged .6 cm. beyond the apex of the appendix. The appendix is very firm and hard to the touch. The external surface is smooth and even; opposite the mesenteric attachment are seven small white oblong tumours, varying from .1 to .4 cm. in length. No lumen can be made out.

Section transversely through the appendix and

middle tumour shows that the latter consists of fibrous connective tissue, containing a few fat cells and large thick-walled vessels. It fills up the lumen entirely, in which no trace of mucous membrane remains. The muscular coats of the intestine are continued round the lower part of the tumour, so as to form a covering for it. On staining with Puro-erythrocin no definite muscular fibres are found in the tumour, which is thus a fibroma of a simple character originating in the submucous layer of the appendix (See Fig. 7).

No. 19. Death from pneumonia. Appendix is 10.2 cm. long and .4 wide. The mesentery is wide at the caecal end of the appendix, consisting of thin connective tissue and containing no fat. Lumen patent throughout, containing some small grey masses towards the free end. A transverse section shows the mucous membrane to contain many crypts. They are narrow, and in many instances branched. Lumen is narrow and contains round cells: lymphoid tissue is well developed, there being definite lymphoid

masses seen in some of the sections. The above description is very remarkable for an appendix of a patient aged 74.

No. 23: Appendix: Only the apex was kept which is seen to be invaginated to the extent of about .4 cm.

C. In this group I have examined 26 appendices, all of which were removed by operation from patients suffering from appendicitis. In most cases serial sections have been cut in order to show the lesions in as much detail as possible.

I have given a table arranged according to the ages of the patients, and showing a few general facts about the cases, and shall describe in detail those that are most important.

No.	Name	Age	Sex	Attacks	Condition of Appendix	Concretions	Length
1	A.G.	7	M.	1	Thickened; 4 Perforations; Abscess	2 laminated	7.8 cm.
2	A.H.	9	F.		Very wide caecal lumen	None	9 cm.
3	A.S.	9	M.	1	Thin adhesions; 1 Perforation; abscess	1 Large	Last 4 cm.kept
4	W.A.J.	11	M.		Slit in theatre	None	Only part preserved
5	A.D.	13	M.	Many attacks	Much kinked and thickened: 2 Perforations: abscess	1 in abscess	Too kinked to measure
6	Th.H.	14	M.		Narrow	One	6.4 cm.
7	J.M.	20	M.		Great bulging from muscular hypertrophy	None	7 cm.
8	C.B.	21	M.	About 20	Embedded in Adhesions	None	4 cm.
9	H.A.C.	22	M.	4	Small, atrophied, contains pus	None	4.2 cm.
10	R.	23			Much hypertrophied	1 Large	5 cm.
11	J.F.	24	M.	1	Adhesions, abscess in mucous membrane	1 Laminated	7 cm.
12	J.P.	24	M.	About 10	Uniform, smooth, narrow	2	8.5 cm.
13	L.M'D	26	M.	4	Has been split, perforated near free end		6 cm.

No.	Name	Age	Sex	Attacks	Condition of Appendix	Concretions	Length
14	B.G.	27	M.	5	Many adhesions	1 Small	Only part kept
15	J.M.	28	M.	6	Smooth surface, normal appearance	None	6.2 cm.
16	M.K.B.	28	F.	4	Kinked and twisted, gangrenous	None	6.5 cm.
17	P.C.	29	F.	6	Widest at middle, narrow caecal end	1 Soft?	4 cm.
18	C.H.	30	M.	1 six weeks	Prolongation at free end	None	4.3 cm.
19	M.E.R.	32			Bent at right angle	1 Soft) 1 Hard)	4.5 cm.
20	W.L.	34	M.	10	Thick and congested narrow lumen	None	8 cm.
21	S.T.	35	M.	10	Has been split, except terminal, 2 cm.	None	Part kept
22	R.B.	39	M.		Great hypertrophy, enlarged glands	None	End kept
23	S.C.	41	F.		Masses fibrous adhesions	None	End kept
24	W.F.	41	M.	3	Has been slit	None	8.5 cm.
25					Split longitudinally and cut as a whole	1 Hard	10.5 cm.
26	M.K.	64	F.		Surface irregular, torn adhesions	3 Hard	6 cm.

No. 1. A.G. Seven years old. Between Friday night and Saturday morning the boy began with sickness. The bowels were opened on Saturday, and after this there was great pain in the lower abdomen. Diarrhoea and sickness then set in, the sickness lasting until Tuesday. The abdomen became distended below the umbilicus, and the patient not improving was sent into hospital on Thursday. A swelling being then visible in the right flank.

Patient was operated on the same day. On opening the abdomen, pus was found, with a track into the pelvis. The pus was wiped away, the appendix found and removed, the neighbouring coils and outside of ascending colon carefully cleansed. A drainage tube was put into the pelvis with 2 strips of gauze to follow the tube and plug the wound.

On Sunday distended coils of intestine were plainly seen. The child had attacks of vomiting independently of food. The packing was removed next day, and the obstruction seemed to subside. The packing was bulky, and had probably compressed a knuckle of bowel. The wound was kept open and packed. A fortnight

later wound was about 3 inches long, widely gaping, faecal matter issued from it. It was then fomented. Ten days later wound was almost healed, and the patient was sent to a convalescent home, after five weeks in hospital.

The appendix was 7.8 cm. long, and about 6 cm. wide. The mesentery was fleshy and extended to the tip of the organ. The apex was bulbous and blunt-pointed. Over the external surface were marks of adhesions. There were four perforations having the position shown in the diagram Fig. 8. No. 4 showed a small rounded piece of tissue, looking not unlike a worm, issuing from a minute aperture in the appendicular wall. It was very brittle, and unfortunately could not be preserved entire. There was a laminated concretion on each side of this perforation, the proximal being the smaller of the two. These are marked out by dotted lines in the diagram. A large piece of thickened omentum was excised at the same time as the appendix.

Sections have been cut of the following blocks:-

Block I. The free end (Transverse)

Block II. Through perforations 1 and 2. Some of the sections therefore show a perforation at the upper and at the lower edge.

Block III. Through perforation 3

Block IV. Through perforation 4

Block V. Through the caecal part

Block VI. Thickened omentum

In Block I, Slide 1, the smallest sections show a dense mass of leucocytes, with blood which lies in the enlarged vessels, but in some parts of the section it lies loose in the connective tissue. In the next larger sections the inflammatory infiltration is not so dense. The muscular walls of the appendix can be made out, but there is no sign of glands or lumen, the centre of the section being occupied by connective tissue with small collections of leucocytes scattered through it. The mesentery is much inflamed, and its vessel walls are thickened.

In the section marked by ink lines there are seen a few groups of cells at the edge of the transverse muscular layer, and lying mostly in the submucous tissue. In appearance they resemble nerve cells,

and are possibly swollen cells belonging to Meissner's plexus.

These cells have been noted only in one other set of sections, No. 9 of the normal group. In the largest sections a mass of necrosed tissue may be seen lying loose in the middle, which has been evidently cut off from the inner wall of the appendix, nearest its mesentery. The sections are not all in order as they were cut in celloidin.

Block II is a series beginning nearest the free end of the appendix. About one-third of the mucous membrane is occupied by a densely inflamed mass of tissue, which stains lightly, and seems advancing towards necrosis. The other two-thirds shows extensive inflammation. The epithelial lining has been partly shed, and lying along the edge of the lumen is a thin layer of leucocytes. This is only seen in a few of the sections. Further on in the series of sections about two-thirds of the mucous membrane is replaced by this lightly stained soft tissue. It extends between the appendix and its mesentery, and

in later sections it is seen to have almost given way, and to be blocked by a piece of necrosed tissue. Further on this is absent, and the perforation has become complete, Fig. 9. At the upper edge of the section opposite the mesentery, the inflammation is not so intense, therefore the coats of the appendix have not given way "en masse," but are still held together by a narrow thread-like portion of tissue. Just below this bridge of tissue is a small mass of fibrin.

This perforation has also become complete as the series procedes (Fig.10).

Block III. The mucous membrane is entirely destroyed. There is a perforation opposite to the mesenteric attachment. Considerable haemorrhage is evident in the lumen. The mesenteric vessels are large and engorged with blood. Towards the caecal end of this block there is a laminated concretion.

Here some of the mesenteric vessels show marked degeneration, the middle coat is occupied by large vacuolated cells. Photograph Block III, Slide 5, Fig. 11.

Block IV. The sections show a centrally placed laminated concretion, in the side of which is a cleft containing round cells, and a few epithelial cells from a crypt. The concretion is crowded with bacilli, a few cocci are also seen. In the section the thionin stain has faded considerably, so that the bacilli can hardly be made out. At the upper edge of the section there is a small perforation which appears to have been formed by two wedges of hardened faecal material, lying between the concretion and the appendicular wall, and pressing upon the latter. A small rounded mass of necrosed tissue protrudes from the perforation.

Photograph, Block 4, Slide 2, Fig. 12.

Block V. Caecal end shows acute inflammation of all the coats. The epithelium is partially shed, but the crypts are seen all round the lumen.

Block VI. Thickened omentum showing great infiltration of leucocytes, engorged and thickened vessels, with blood lying loose in the connective tissue in places.

No. 2. A. H. Female, 9 years old. The appendix is remarkable for its size, being 9 cm. in length and 1.5 cm. wide at its caecal end. The apex is tapering, and the seat of fatty degeneration. Proximal to the apex the lumen is occluded by a clot consisting of red blood corpuscles with many leucocytes. The details of the epithelium are lost in a dense mass of inflammatory tissue.

No. 3. A. S. Male, 9 years, one attack.

History - 22nd May sudden severe attack of epigastric pain. Vomited once. Bowels moved 2-3 times after castor oil.

23rd - Was seen by a doctor. Child lay on his back, with legs drawn up. Abdomen flat, hard and tender. Severe epigastric pain. Pulse 110-120, temperature 101°-103°.

26th May - Operation. Pus escaped when peritoneum was opened. Pelvis is part of the abscess cavity. The appendix was found gangrenous and perforated at its free end. There was a second abscess rather above this. Part of the appendix was left,

and anchored to the muscular tissue near. The rest was ligatured and removed. A rubber tube was inserted. 27th June - Belt and pad. 7th July - Sent to convalescent home. 17th July - Discharged.

On examination of the terminal 4 centimetres of the appendix, it is found to have marks of adhesions all over it. The outer muscular coat is much torn. The apex is bulbous and contains a large concretion. Proximal to this the appendix is perforated.

Block I. Cut transversely through the apex. Sections show inflammatory tissue. The lumen is entirely occluded. Proximal to this section is a large concretion. The tissue surrounding it is completely necrosed. The appendix is almost perforated opposite the mesentery. Proximal to the concretion there are two small localized patches of mucous membrane which have escaped the general destruction.

Block II. The whole section shows dense infiltration of leucocytes, the peritoneum is greatly thickened. The lumen is represented by a narrow slit, clinging to its edges are a few scattered

epithelial cells. Near the caecal end the mucous membrane is normal in appearance, but the lumen contains pus with bacilli and cocci. Bacilli can also be seen with the 1/12" lens to have penetrated the crypts.

No. 4. W. A. J. Male 11: The appendix was split at the operation. Sections show inflammation of moderate extent and degree. Lymphoid nodules are well marked in the mucous layer. The crypts are few in number, but are very wide, and contain no goblet cells. The epithelium is absent in places.

No. 5. A. D. Male, 13: Patient began with pain in the right iliac region in January. He left work, and went to bed, where he still remains (May 26th). He has passed blood twice and mucus often. The attacks were frequent, sometimes three hours between them, sometimes a day. Patient says the pain was often preceded by hunger, and disappeared on taking food. He vomited twice before coming in, and sometimes 7-8 times in one day.

Admitted to hospital 17th April. There is pain in the right iliac region. The abdomen is tense and distended, especially just above and to right of the umbilicus. There is pus in the motions. Temperature is normal.

20th May - There was an incision 4 inches in length made over the appendix. The right testicle was undescended and removed. The appendix was surrounded by adhesions which were broken down. Pus was found behind the appendix which was perforated with a concretion behind it. It hung into the pelvis, and thus pus had entered the rectum.

Examination of appendix. It is very irregular in shape, and cannot be accurately measured owing to its constrictions and bends. There are many tough adhesions which have been broken down in operation. There is also an irregular mass of glandular and fibrous tissue.

Microscopic examination was made of four blocks:-

Block I - Apex much flattened. Cut transversely, Slide 4. At one side of the section there is a

mass of inflammatory tissue which has evidently been the mucous membrane of the appendix, and which shows a cleft opening to the exterior, the remains of the lumen. A few short rows of cubical epithelial cells can be seen lining it in places. This perforation is very small in extent, and proximal to it the mucous membrane and the lumen are present in their normal positions in the centre of the section. Photographs of Block I, Slide 4, Figs. 13 and 14.

Block II. Sections taken transversely through a perforation at the middle of the appendix. The perforation is large and recent, and situated opposite the mesentery, at the point of greatest strain, where the appendix has been tightly kinked.

In the previous block the perforation was seen to be at the mesenteric attachment. The perforations I have examined in this situation have been small and ulcerative, and the few epithelial cells present have often been cubical in shape, while those found opposite the mesentery have usually been large and ragged. The epithelium has been

exposed, a layer of fibrin often blocking the mouths of the crypts. Fig. 16 shows an enlargement of one of the crypts, its opening being blocked by fibrin. The large columnar cells are well shown. The epithelium is loosened from the adjacent lymphoid tissue. Sometimes there is a reflection of part of the appendicular wall over the mucous layer, and the epithelium is to some extent thus covered in and protected. Fig. 15.

Block III. Section through caecal portion appears almost normal in character. Only slight desquamation of epithelium. Mucous and pus cells in lumen.

Block IV. Section through undescended testicle.

No. 6. T. H. Male 14. On October 6th patient began to suffer from acute pain all over the abdomen. He did not vomit that day, but was twice sick on the 7th. The pain continued, gradually becoming less severe until October 13th. Bowels obstinately confined. On the 15th the pain was localized at

McBurney's point where there was tenderness on pressure. Operation on the 16th October. On opening the peritoneum a collection of pus was discovered on the inner side of the caecum, extending down into the pelvis at the side of the bladder. A concretion was found in the abscess cavity, and the appendix was discovered tucked down behind the caecum amongst adhesions.

Five blocks examined taken from the free to the caecal end.

Block I shows the muscular coats to be obliterated by round cells. In the lumen is a delicate network of mucin in which are entangled round cells and bacilli.

Part of the epithelium is shed. It contains many goblet cells from which mucous is seen to issue. Bacteria are seen in the mouths of the crypts. At the proximal part of the block a considerable amount of blood is seen lying free in the lumen.

Block II: Inflammation less intense, the muscular coats can be defined. Some of the vessels show de-

generation of the middle coat with vacuolated cells similar to that in the case of A. G., No. 1.

Block III. Proximal to 2. The section is through a concretion. The concretion is large and laminated, fitting tightly into the lumen. The mucous membrane surrounding it is devoid of glands or epithelium. In the centre of the concretion is a soft core, it contains very few cells. Bacilli are abundant in the laminae. Various cells, probably of vegetable origin, are incorporated in the concretion.

Block IV. Proximal to the concretion the lumen is occupied by a mass of inflammatory tissue and is almost obliterated. There are a few much flattened epithelial cells near the centre of the section.

Block V. Through the caecal end, shows glands with enormous numbers of goblet cells. There is a good deal of peritonitis present, and the lumen contains pus, cells, mucin and bacilli.

No. 7. J. M. Male 20. Three blocks examined.

Transverse sections. 1, Free end; 2, Mid part, show simple inflammatory changes; 3, Caecal end. The lumen is placed eccentrically. It shows necrosis on the narrow side, and on the other side the mucous membrane is almost intact. The epithelium can be traced along its whole extent. The lower cells in the crypts stain deeply, and there are a few goblet cells. The lumen contains chiefly red blood corpuscles with mucus, a few round cells, bacilli and streptococci.

No. 8. C. B. Male 21, Cabinet-maker. Admitted 15th March, operation 25th March, discharged 13th April. The patient had an attack of pain in the abdomen a year ago, originating from a blow. Last September the patient had an attack, which began suddenly while he was at work, and lasted a month. He has had attacks of pain in the caecum about every week since. The last was on the 13th March. The pain is severe, and lasts about an hour when it is sharp and stabbing in character, and does not radiate.

There is no tenderness or swelling.

At the operation adhesions were found between the appendix and caecum. The appendix was drawn out of a pouch, it had a dilated end.

Examination of appendix. It is a small hard appendix covered with fibrous masses, ridges, and marks of torn adhesions. The mesentery cannot be made out, and the walls of the appendix are hidden by the tissue round about. Sections were taken from two blocks.

Block I shows a mass of dense fibrous connective tissue, in the centre are a few crypts cut transversely. No details of the other coats of the appendix can be made out. The lumen has not been reached. The section is very irregular in shape.

Block II. Proximal to 1. In the centre of the section is some altered blood lying in an open space, surrounding this is some connective tissue, containing in parts many round cells, and in parts undergoing necrosis. Outside the connective tissue are large groups of fat cells, giving to the

centre of the section, when viewed directly, a vacuolated appearance. Beyond this tissue are the muscular coats of the intestine which appear to be normal. There are many groups of fat cells in the mesentery.

No. 9. H. A. C. 22. History - Patient had two attacks of acute indigestion, one in April, following a bathe, the other some months previously. In neither case had there been any indiscretion in diet. Previous health fair, no dyspepsia; enteric at age of 4. On the 6th of June the patient, being in his usual health, after a hurried meal of meat went to the theatre, where he sat in a draught and felt chilly. On returning he vomited, and had severe abdominal pain and diarrhoea, which continued throughout the night. Next morning the pain was localized at McBurney's point, where there was distinct tenderness on pressure. The pain was very severe, coming in paroxysms. Slight hiccough was present. The temperature in the morning was 100.6° and 103° in the evening. A little opium was given in the morning and patient was given no food except a

little milk. At 2 p.m. hot fomentations were applied and continued until 10 a.m. next morning, when temperature was 99°, and pain was diminished, and no longer paroxysmal in character. Hiccough had quite disappeared. There was still great tenderness. On June 9th a swelling in the right iliac fossa was made out. On 10th still slight tenderness. On 11th bowels moved after calomel and two enemata. Patient made an uninterrupted recovery and got up on tenth day. On August 7th Patient had another attack of "acute indigestion," which was almost certainly another attack of appendicitis. Late in September the patient suffered again from undoubted appendicitis. The pain was very severe and lasted longer than on the previous attacks, and he was kept for three weeks in bed. He did not make a good recovery, and continued subject to pain and discomfort in the iliac fossa. On November 7th operation was performed for the removal of the appendix.

The appendix was bound down by numerous adhesions. It contained pus, a little of which

was spilt when it was removed, and which, in spite of most careful washing, infected the wound. Patient was somewhat collapsed after operation, and was fed by the rectum for three days. On the fifth day an abscess containing foul green pus burst externally.

The appendix was 4.2 cm. long, narrow and atrophied looking, with marks of torn adhesions all over the external surface. Lumen patent, and contains yellow semi-fluid material. On microscopic examination the walls were found atrophied. Lumen is wide and very various in shape, and extended through the mucous membrane. It contains pus in which cocci are seen. Inflammatory infiltration in the muscular walls. In longitudinal section an exceedingly well-marked "hiatus muscularis" is seen.

No. 10. R. 23. Appendix is much hypertrophied, and contains one large very hard concretion.

No. 11. J. F. 24. History - Patient quite well until July 9th, when he awoke with slight abdominal pain. Next day much worse, with tenderness at

McBurney's point. He was seen by a doctor and given a sedative and castor oil. On the 11th bowels moved early in the morning. There was general abdominal pain, and tenderness, and slight jaundice was noticed. On 12th enema of olive oil. Temperature 102° to 103°, and sent into hospital.

On 13th temperature 102.5°. General distension of abdomen and great tenderness, and the transverse colon is distinctly visible. Bowels have not been moved since 11th, a small amount of flatus has been passed. There is copious bilious vomiting. Operation was performed for intestinal obstruction. Some oedoema between transversalis fascia and peritoneum. Free fluid in body-cavity. The appendix was found to the outer side of the caecum, surrounded by adhesions. It was gangrenous and ruptured. A large concretion was present blocking the appendix, between the ruptured part and the caecum. There was an abscess containing foul pus, and bounded by the appendix.

The appendix was excised. Patient died on 16th.

Examination of Appendix; 7 cm. long. It was slit longitudinally, and the two ends are flexed towards the mesenteric border. The muscular wall is thick at the proximal end, but is thin all over the middle portion, and thickens again distally. At the mid-point of the appendix is a deep furrow in the mucous membrane. There was a hard concretion with the specimen.

Sections - Block I, Terminal end shows marked fatty degeneration.

Block II, including the furrow. On the proximal cut surface there are two small pits in the mucous membrane, nearest the mesenteric attachment. They appear to be minute abscess cavities, but as they were not stained for micro-organisms, one cannot say whether they contain pus or not. The surrounding parts are partially necrosed with patches of tissue infiltrated by round cells. No trace remaining of the mucous membrane. Mesentery shows marked inflammation and contains many fat cells.

No. 12. J. P. History - 1st attack on January 7th. Began with an aching pain which became boring in character, doubling him up. Continued severe all night. No swelling was noted. The attacks subsequently occurred every two or three weeks. At the fifth attack he vomited, and also in a later one. Bowels regular throughout. Pain did not grow worse than in the first attack. The last attack was on June 12th, when distinct tenderness over McBurney's point was found; relieved by hot fomentations. Operation on June 17th. The appendix was firmly adherent to the caecum, and was kinked and obstructed near its origin. Appendix is 8.5 cm. long, and of nearly uniform thickness throughout. It is bent at an angle about its middle point, but the lumen is not constricted and is patent throughout. The walls of the appendix are very thin in parts. There is a concretion at the free end, and one at the proximal end, just distal to the reflected cuff of peritoneum. On section this concretion is seen to consist entirely of round cells with a small nodule of faecal matter embedded in it. It contains bacilli.

There is very little inflammatory infiltration in the muscular coats, differing in this respect very much from the last case.

No. 13. L. McD. No history.

Appendix on microscopic examination shows thickening of the peritoneum with collections of round cells, specially surrounding the vessels. The mesentery is also much inflamed, and scattered through the muscular coats are some groups of round cells. Rows of round cells are seen to be lying between the blocks of longitudinal muscular fibres and extending from it into the mesentery. In the transverse layer these groups lie for the most part in the opposite direction, and are broader than those seen on the longitudinal layer. The submucous tissue also shows round-celled infiltration with some blood lying loose in it. There are lymphoid nodules in the mucous membrane, and abundance of lymphoid tissue, so that it is difficult to say whether there is inflammation here or not. Crypts are not very numerous, and are absent along the mesenteric side

of the lumen. The epithelium is well marked and continues throughout, and clinging to the inner edge are a few cells, probably pus.

The appendix was slit at the operation.

No. 14. B. G. History - He had five attacks in four years. Four years ago he was seized on one occasion with sudden griping abdominal pain, which continued intermittently for a week. The following year he had two attacks, about the same in character as the first. Two years ago he had a very severe attack, the pain lasting three weeks, and the patient being off work for seven weeks. It was situated in the right iliac region, sometimes in the groin, never in the testicle. A fortnight before admission to hospital the same pain came on immediately after breakfast. Complete constipation for four days, then a small motion was passed with great pain and a small amount of blood. Admitted to hospital on May 24th. He was very constipated, and complained of a stinging pain on micturition, and a shooting pain in the groin. On palpation a hard mass is

felt in the right iliac fossa, 2" to the inside of the anterior spine, and at a rather lower level. This is very tender on pressure. Operation was performed on May 27th. The appendix was found adherent to the caecum, close to which it was constricted. There was concretion the size of a hempseed, lying near the free end. The appendix was opened and split in the theatre, and free end was kept for microscopic examination. The entire block was cut in serial sections, few being omitted.

Microscopic examination - Block cut transversely. The first section shows slight inflammatory infiltration of the mesentery and muscular coats. Last section on Slide 2 shows a lymphoid nodule, outside the muscular coats, lying in the peritoneum. In subsequent sections it is seen to have formed the tip of the appendix, which now shows lumen, crypts with goblet cells lying in the centre of the lymphoid tissue, and epithelium. In the lumen are a few round cells with strands of mucus . Below this there are indentations in the muscular coats, which become deeper in subsequent sections, until the lumen finally

assumes its normal position, being almost in the centre of the section. Figs. 18, 19, 20, 21. Up to slide 4, there is no evidence of the scissor cut. After this the cut has involved some of the coats, the lumen not being opened into until slide 18.

Slide 8 shows mucous membrane in scattered portions, lying in the muscular layer. In subsequent sections these are seen in the mesentery. Slide 12 shows a growth of mucous membrane, from the central lumen extending down in the submucous layer, and forming a diverticulum, the shape of which is seen by naked eye examination of the section. This also demonstrates the manner in which the mucous membrane reaches the mesentery. On looking, see sections 12 to 9. Figs. 23, 24.

No. 15. J. M. History - Patient had an accident, and was hurt internally four years before he came under observation. Two and a half years ago he had his first definite attack of appendicitis. He has had five attacks since. Each attack began with

intense pain in the abdomen, nausea, vomiting and sweating. On admission to hospital he complains of a little pain in the abdomen, but is in good condition. There is some tenderness at McBurney's point. No swelling or distension. At the operation the appendix was found very adherent to surrounding parts. It was 6.2 cm. long, the apex was embedded in fat. The external surface was fairly smooth and uniform, with a few marks of adhesions. No concretions and no hypertrophy.

Block I. Through apex. Microscopic examination shows presence of much fat, and great congestion, with thickened vessels.

Block VI, shows peritonitis, inflamed muscular walls, submucous layer well marked and contains large vessels, round each of which are some large purple stained homogeneous cells, resembling fat cells.

No. 16. M. K. B. History of four attacks, the last being very severe. Operation on December 13th. Examination of appendix. It was 6 cm. in length,

1 cm. at its widest, and .2 cm. at its narrowest point, which was at the middle of the organ. The mesentery is congested and from it enlarged vessels are seen, crossing over the surface of the appendix. The apex is blunt-pointed, and its last half centimeter is suddenly narrowed to about 1.3 cm. This last portion is of a dark purple colour, acutely flexed and closely adherent to the adjacent portion of the appendicular wall. The external surface shows some depressions and irregularities. At the middle point a sharp twist is seen. The distal part of the appendix being turned through about 3/4 circle on to the proximal. The adjacent surfaces of this twist are seen to be denuded of peritoneum, the appendix being completely doubled on itself in addition to being twisted. Fig. 24. At the apex of the appendix the vessels are thrombosed, and there is a layer of altered blood almost surrounding the mesentery. There is a small mass of dense connective tissue containing large vessels, and a small amount of lymphoid tissue, marking the extreme tip of the appendix. Proximal to this the lumen

shows glands. The mucous membrane is fairly normal in character, and shows glands cut transversely and the lumen eccentric in position. Fig. 25. Proximal to this the lumen is occupied by newly formed granulation tissue.

Sections through the twisted middle portion. The larger section on slide 5 shows the portion beyond the twist. The lumen is lined by epithelium with crypts and lymphoid tissue in the mucous membrane, the lymph spaces round the crypts in one of the sections are very well shown.

The smaller section shows the appendix proximal to the twist. The mucous membrane appears to be normal in character. The mesentery is inflamed and shows large dilated blood vessels. There is a small concretion in the lumen.

No. 17. P.C. History - Patient, sister of Case 9, had six attacks extending over a period from December 18th 1896 to November 1898. Previous health good, no dyspepsia, constipation or diarrhoea. Severe enteric fever at age of 11. The first attack

was considered to be acute indigestion, the pain lasting for one night. This attack was not diagnosed as appendicitis, but viewed in the light of subsequent events it seems probable that it was the first onset of the disease. On May 11th 1897 she had a definite attack of appendicitis. A sausage-shaped swelling was made out on the fifth day. For several weeks after the acute attack was over, temperature rose about 2^{o} after meals.

On 2nd July patient had another attack, attributed to eating lettuce, no vegetables having been taken since previous attack. The attack was slighter than the first. On July 27th a fourth attack occurred. On August 7th there was a slight attack. After this date patient had no definite attack until November of the following year. This attack came on whilst bicycling up a steep hill, when suddenly a sharp pain was felt in the right iliac fossa. This became worse at night, but was less severe than in the first attack. There was distinct increased resistance in the right iliac fossa, with slight swelling and tenderness. After three days

the acute pain had quite subsided, and was succeeded by a dull, aching, intermittent pain which usually came on after meals. Temperature was never very high, but never touched normal, ranging between 99.4° and 100.8°, usually highest in the morning. The patient was kept in bed for twelve days and in one room for four weeks, but these sub-acute symptoms did not disappear.

The appendix was excised on December 31st. At the operation a considerable amount of serous fluid was found in the abdominal cavity. The appendix was slit in the theatre. The appendix was free, no adhesion. It contained two soft concretions, which would probably not have been able to pass out into the intestine, as the caecal lumen was narrower than the concretions. It was widest in its mid part. Section through the apex shows several small masses of round cells in the muscular layer. The rest of the section shows nothing abnormal.

Block IV. Through widest portion of appendix, shows well-marked lymphoid nodules below the level of the crypts, which are small and not very numerous.

There is no special evidence of inflammation.

Block V shows the narrowed caecal end. The section shows large vessels and fat cells in the submucous layer. Regarding the occurrence of appendicitis in members of the same family, Treves states that he has found it to be more frequent in brother and sister than in parent and child. H. A. C. and P. C. were two out of three children, the third, a sister, who came between them in age, not having had appendicitis nor enteric fever.

No. 18. C. W. H. History - Admitted to hospital on October 26th suffering from an attack of appendicitis which had lasted for seven weeks. The pain lasted from five to six hours, and then disappeared for a time. It was sharp and stabbing in character. Bowels regular, appetite good, and no vomiting. Sometimes much flatus was passed. Operation on 20th. Appendix was very adherent, the extremity projecting over the brim of the pelvis and firmly adherent to the external iliac vein. He had an abscess, but otherwise made a good recovery.

Appendix 4.3 cm. long, and has been split. A prolongation .3 cm. long is noted at the apparent end of the appendix. In section the lumen is found continued into the prolongation, which has also been slit, but the lumen has not been opened up. Fig. 26.

Fig. 27 is an enlargement of the central part of the previous section, showing the lumen, containing pus, and having one short row of cubical epithelium cells representing the entire mucous lining.

Fig. 28 proximal to the last shows the mucous membrane completely lined with epithelium. At one point there is an overgrowth of these cells, which appear to be heaped up on one another. It also shows the different shape of the lumen in adjoining sections.

Block II from the mid part of the appendix. A cylindrical mass of tissue is lying in the lumen, attached to its mesenteric side. This is seen to consist of granulation tissue, containing a few groups of lymphoid cells, probably the remains of the follicles of the mucous membrane. This section recalls M. K. B.

Block I - distal section.

No. 19. M. E. R. Appendix bent at right angles 1.5 cm. from its proximal end. A soft concretion is found just proximal to the bend, and a hard concretion .2 by .3 cm. at the distal end.

Block I containing the distal concretion has been sliced round longitudinally, and the ends of the block cut parallel to each other. The sections show well marked wide gaps in the muscular tissue, through which the inflammatory infiltration is seen to be spreading. Fig. 29.

No. 20. W. L. History - Has had ten attacks in the last eight months whilst in Singapore. Came home for operation which was done on October 24th.

The appendix was much congested and slightly adherent to the posterior surfaces of the caecum. It was lying in an abscess which was shut off from the general peritoneal cavity by adhesions. The appendix was ligatured at its base and cut off, wrapped in sterilized gauze, and conveyed straight to

the pathological laboratory. A cut was made through the mucous membrane near the free end, with a sterilized knife, and a sterilized wire was introduced into the cavity, which was then inserted into a Bouillon tube, October 24th 4 p.m. On October 25th 12 noon, the broth was seen to be turbid. Coverglass preparations stained with Loeffler's blue show bacilli. On October 26th broth shows a white deposit and greater turbidity.

27th - noon. An agar tube was inoculated from the broth culture.

29th - noon. The agar tube has copious white groups, and shows two large gas bubbles. Coverglass preparations demonstrate the presence of pure culture of B. coli.

No. 21. S. T. History - Previous to admission to hospital had ten attacks, the first five years ago. It is stated that as a child, between 8 and 14 years of age, he suffered from attacks of abdominal pain and vomiting, lasting three or four days. Since then been liable to constipation. After the worst

attacks patient has passed slimy motions, never blood or matter.

Symptoms on admission, November 14th. Abdomen shows no rigidity, general tenderness nor swelling. On deep palpation a cylindrical body is felt to roll beneath the finger. There is a tender point 3.5" internal, to the anterior iliac spine, and patient says he feels pain passing up a line which he indicates as being from McBurney's point to the epigastrium, 3" above the umbilicus. Operation on 23rd.

Appendix adherent, thickened distally and containing a softish mass of faecal concretion.

Longitudinal section through apex shows great muscular hypertrophy, and no special signs of inflammation.

No. 22. R. B. Appendix. End exceedingly wide and quadrilateral in shape. Muscular walls show great hypertrophy and some inflammation. The mesentery is congested and contains several large glands. Crypts are short and some protrude far

from the lymphoid setting. They are absent over part of the mucous layer. A few round cells and mucin.

No. 23. S. C. Appendix - Apex embedded in masses of firm fibrous tissue. In the mucous membrane are two lymphoid nodules, one of which is seen to be breaking down to form what is probably an abscess.

Fig. 31. Proximal to this the appendix is greatly thickened, showing much inflamed mesentery, peritoneum and muscular coats. In the submucous layer there are many fat cells and considerable round-celled infiltration.

No. 24. W. F. History - Had first attack seven or eight years ago. It lasted three days and was characterized by severe pain and vomiting. Last April he had another attack of a fortnight's duration. On July 18th he had a third attack, and was admitted to hospital on August 9th. Operation performed same day. The appendix was thick and ulcerated, and surrounded by a mass of matted adhesions. These

were broken down and the appendix was ligatured and excised. The distal end was cut longitudinally to show the muscular layers. Very little inflammation is seen.

Block II shows a broad band of inflammatory infiltration extending into the mesentery, and perforating into it.

Block IV shows the narrow caecal end; the mucous membrane is absent, its place being taken by connective tissue. In one or two of the sections traces of a lymphoid nodule may still be seen.

No. 25. An entire appendix mounted on cork to obtain continuous longitudinal sections. At a point 1.4 cm. from the proximal end an oblong hard concretion is found.

Mucous membrane is extensively destroyed in this situation. Shows excessive inflammation throughout, of all the layers. Figs. 32, 33.

No. 26. M. K. History - Patient was admitted to

hospital with abdominal symptoms of a doubtful nature, which led to the exploration of a right femoral hernia which was present. Pus was found in the hernia, as well as hernial contents. On extending the incision the pus was found to be due to appendicitis.

Appendix was 6 cm. long. External surface irregular, with marks of torn adhesions. It shows three large bulges, at the mid part, the free end, and one between these two. No kinking present. On section concretions are found on each of these bulgings, and hardened faeces fill the rest of the lumen, except proximally where there is considerable haemorrhage into the mucous membrane. There is a small perforation proximal to the mid bulge, just at the junction of the mesentery and appendix. The free end is prolonged into a narrow process in which the lumen can be traced (Block I).

Block II, slides 3, 4, show the perforation.

Block II, slide 5 shows the concretion.

On considering these cases from the clinical point of view, one is impressed by the excellent results obtained by operation. In twenty cases, many of which showed serious lesions, there was only one death. This is a very large proportion when contrasted with similar cases described a few years ago. This success must be attributed to the greater skill in diagnosis, and the fact that such cases now pass much earlier than formerly into the hands of the surgeon.

As applicable to appendicitis generally I may quote in conclusion an extract from an interesting paper, which appeared in the Gazette hebdomadaire July 26th, 1900 by MM. les Drs. Bonneau et Ardebert on the subject of appendicitis complicated by pregnancy. "As far as concerns the appendicitis of the gravid state, we can agree with the famous aphorism 'It n'y a pas de traitement medicale de l'appendicite,' in the sense that sooner or later resection of the appendix will require to be performed. But we should only agree to the aphorism with the addition of this restriction formulated by

Broca, that non-operative treatment will sometimes abort an attack, delay the moment of intervention, and replace the dangerous operation à chaud, by the operation à froid which is absolutely without danger."

EXPLANATION OF PLATES

Fig. 1 Caecal diverticulum of bluetit x 90

Fig. 2 Caecal diverticulum of chick x 12

Fig. 3 Foetal appendix

Fig. 4 Foetal appendix

Fig. 5 Carcinoma of appendix (rare) x 12

Fig. 6 Gap in muscular wall of appendix x 12

Fig. 7 Simple tumour of appendix x 12

Fig. 8 Whole appendix showing perforations, and site of concretions marked by dotted lines (life size)

Fig. 9 Perforation of appendix x 12

Fig. 10 Perforation x 12

Fig. 11 Perforation x 12

Fig. 12 Perforation x 12. These four are from the same case

Fig. 13 Perforation x 20

Fig. 14 Enlargement of previous figure x 420

Fig. 15 Perforation x 20

Fig. 16 Enlargement of previous figure x 420. These four are taken from the same case.

Explanation of Plates Contd.

Fig. 17 Eccentrically placed lumen of appendix x 60

Fig. 18 Lymphoid nodule of apex of appendix appearing outside the muscular coats x 12

Fig. 19 Section from same case showing indentation of the muscular coat x 12

Fig. 20 Shows deeper indentation of muscular coat x 12

Fig. 21 Muscular tissue surrounds the lumen x 12

Fig. 22 Nodules of lymphoid tissue with a few glands lying in the mesentery x 15

Fig. 23 Shows diverticulum of mucous membrane passing down from the lumen, to right of figure x 15

Fig. 24 Inflamed apex beyond lumen x 60.

Fig. 25 Apex with glands cut transversely x 60

Fig. 26 Prolongation of apex of appendix. Scissor cut which has escaped lumen passes obliquely across section x 60

Fig. 27 Enlargement of previous section x 100

Fig. 28 Lumen proximal to last figure x 100

Fig. 29 Wide gap in muscular coat extending from submucous to peritoneal coat x 15

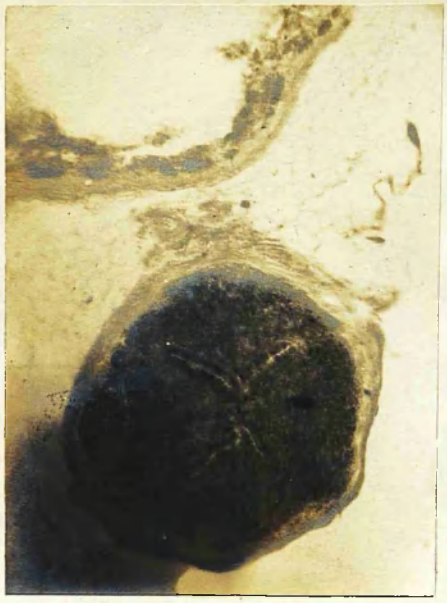
Fig. 30 Upper portion of last figure x 15

Fig. 31 Lymphoid nodule breaking down to form pus x 60

Explanation of Plates Contd.

Fig. 32 Whole appendix mounted on cork. Natural size

Fig. 33 The same at a level nearer the lumen. Natural size.



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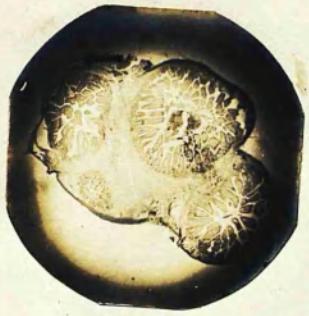

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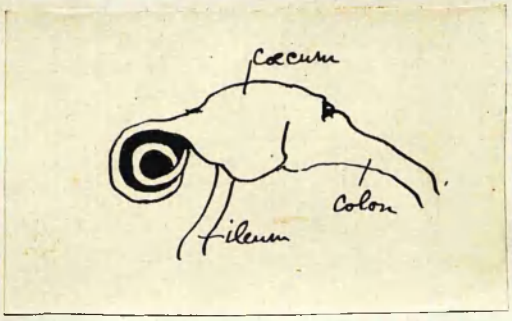

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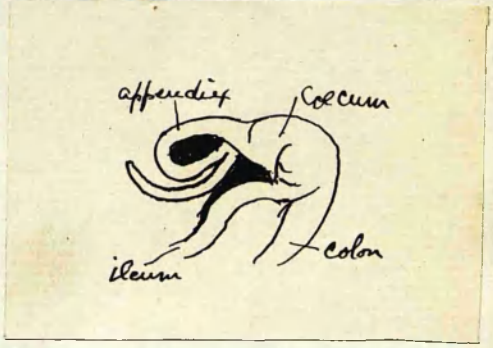

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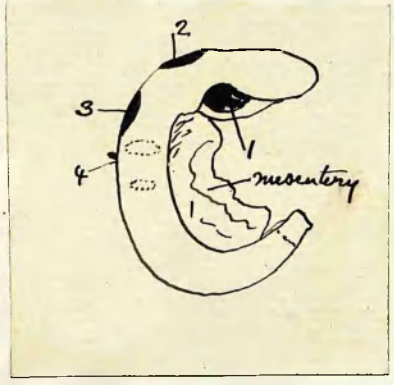

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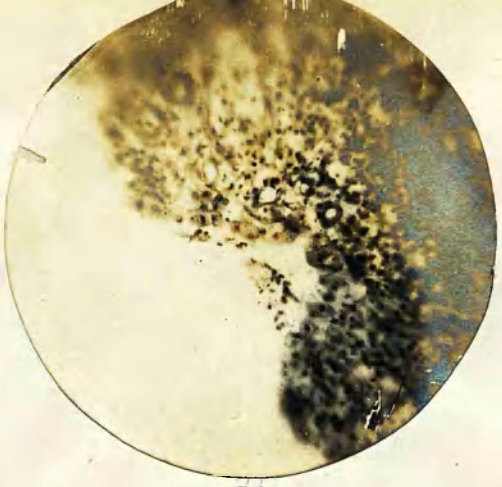

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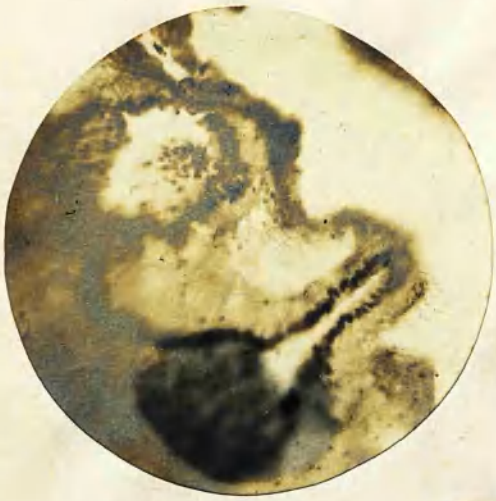

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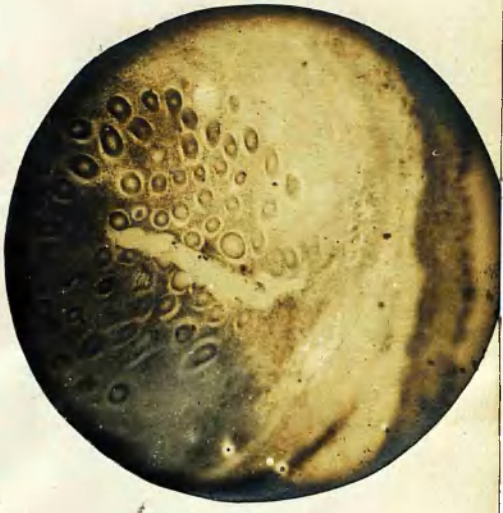

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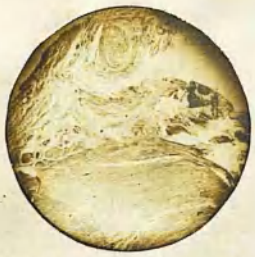

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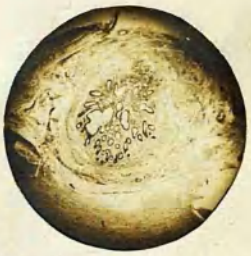

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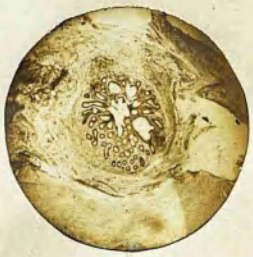

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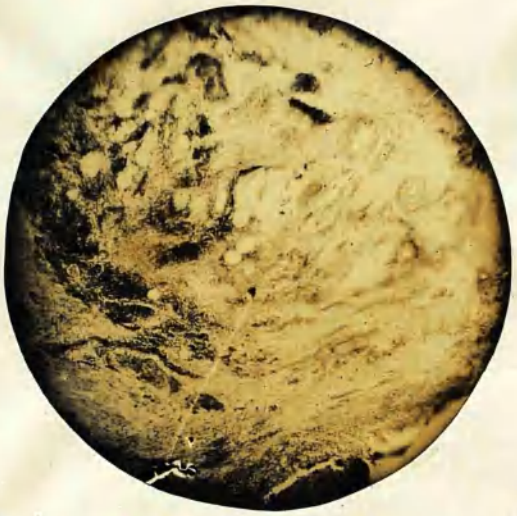

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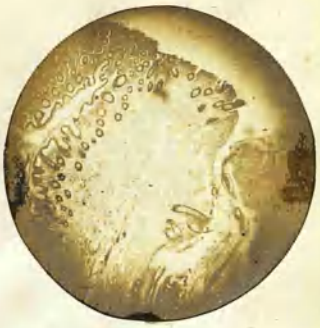

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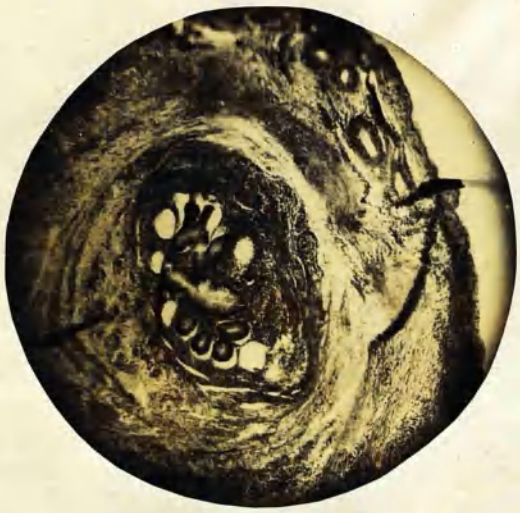

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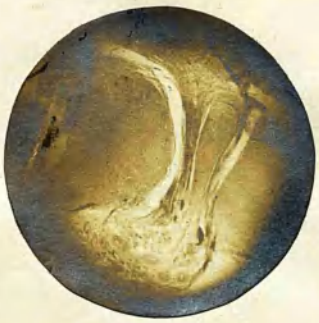

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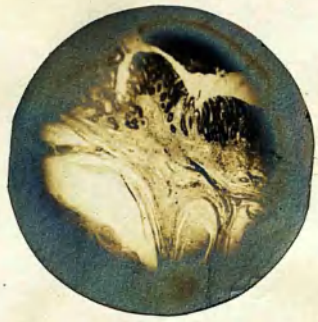

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